## REMARKS

Applicant appreciates the Office's review of the present application. In response to the Office Action, the cited references have been reviewed, and the rejections and objections made to the claims by the Examiner have been considered. Applicant thanks Examiner for the withdrawal of the previous restriction requirement mailed on 07/12/2005. The claims presently on file in the present application are believed to be patentably distinguishable over the cited references, and therefore allowance of these claims is earnestly solicited.

In order to render the claims more clear and definite, and to emphasize the patentable novelty thereof, claims 2, 4, 7-10, 23, 29, and 33 have been amended, claims 1, 5-6, 11, 15-16, and 24-25 have been cancelled without prejudice, and new claim 34 has been added. Support for any new claims is found in the specification, claims, and drawings as originally filed, and no new matter has been added. Accordingly, all claims presently on file in the subject application are in condition for immediate allowance, and such action is respectfully requested.

## Rejections

Rejection Under 35USC Section 103

Claims 7, 23, and 29-32 have been rejected under 35 USC Section 103(a), as being unpatentable over Japanese published patent application JP 11129472 by Naoki ("Naoki") in view of U.S. patent 6,438,497 to Mansky et al. ("Mansky"). Applicant respectfully traverses the rejection and requests reconsideration based on the amendment to claims 7, 23, and 29, and features in the claims which are neither disclosed nor suggested in the cited references, taken either alone or in combination.

As to a rejection under 103(a), the U.S. Patent and Trademark Office ("USPTO") has the burden under section 103 to establish a *prima facie* case of obviousness by showing some objective teaching in the prior art or generally available knowledge of one of ordinary skill in the

art that would lead that individual to the claimed invention. *See In re Fine, 837 F.2d 1071, 5 U.S.P.Q.2d 1596, 1598 (Fed. Cir. 1988)*. The Manual of Patent Examining Procedure (MPEP) section 2143 discusses the requirements of a *prima facie* case for obviousness. That section provides as follows:

> To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and reasonable expectation of success must be found in the prior art, and not based on applicant's disclosure.

In the present case, the Office has not established a *prima facie* case of obviousness because there is no suggestion or motivation to modify the reference or to combine reference teachings, there is no reasonable expectation of success, and the applied references do not teach or suggest all of Applicant's claim limitations.

Independent claim 7 (amended) is patentably distinguishable over the cited references because claim 7 emphasizes the novel features of the present invention in which two pressure sensors of a print head detect pressure waves in substantially orthogonal directions. In this regard, claim 7 recites:

> "7. (Currently amended) A print head apparatus, comprising:
> a substrate;
> an ink expulsion mechanism provided on said substrate;
> an ink well defined proximate said ink expulsion mechanism and a nozzle formed as an egress from said ink well;
> a first pressure sensor that is formed substantially at said ink well and configured to detect pressure waves in a first direction induced by a firing of said ink expulsion mechanism; and
> a second pressure sensor configured to detect pressure waves in a second direction induced by the firing of said ink expulsion mechanism, wherein said first pressure sensor is an acoustic wave piezoelectric transducer and said second pressure sensor is an interdigitated pressure wave transducer and wherein the second direction is substantially orthogonal to the first

direction." (emphasis added)

The Naoki reference (Figs. 1 and 5) describes an ink jet head in which only a single sensor (distortion sensor in diaphragm 55) for detecting pressure waves is associated with a corresponding ink expulsion mechanism (heater 21).

The Mansky reference is not directed to printing with a print head, but rather with rapidly performing materials characterization with a sensor array. The Mansky reference describes "a characterization method that uses a modular, electrically-driven sensor array in a selected standardized integrated electronic platform to characterize a plurality of materials simultaneously and rapidly" (col. 1, lines 16-21). An acoustic wave sensor 170 (Figs. 17A-B) is used "for measuring material properties such as viscosity, density, elasticity, and capacitance", and also "can measure the dielectric constant and the conductivity of the material" (col. 37, lines 3-12). The features of the present invention are neither disclosed nor suggested by the Naoki reference in combination with the Mansky reference in that there is no teaching or suggestion that the acoustic wave sensor of the Mansky reference can detect pressure waves induced by the firing of an ink expulsion mechanism.

In the Mansky reference, multiple sensors may be used in an array to rapidly characterize "a plurality of organic or inorganic materials" (col. 1, lines 16-17), "wherein each sensor supports at least one sample of five or more samples and characterizes at least one material property of the sample supported thereby and measures at least one material property of the five or more samples at a rate of at least one sample every 2 minutes" (Abstract). However, there is no teaching or suggestion that more than one of the acoustic wave sensors is configured to sense the same event or condition. Therefore, the features of the present invention are neither disclosed nor suggested by the Naoki reference in combination with the Mansky reference in that there is no teaching or suggestion that two pressure sensors are configured to sense pressure waves formed by a particular firing of a particular ink expulsion mechanism.

Furthermore, claim 7 recites that the first sensor detects pressure waves induced by the firing of the ink expulsion mechanism in a first direction, and that the second sensor detects

pressure waves induced by the firing of the ink expulsion mechanism in a second direction orthogonal to the first direction. The features of the present invention are neither disclosed nor suggested by the Naoki reference in combination with the Mansky reference in that there is no teaching or suggestion that pressure waves in orthogonal directions are detected by different sensors. With regard to a similar limitation recited in claim 9 (discussed below), the Office stated that "Mochuzuki et al. discloses a surface acoustic wave detector having at least two interdigitated sensors that are provided in a substantially orthogonal arrangement on a substrate (FIG. 2-3, elements 12-1, 12-2, and 14)" (Office Action, p.6). As recited in claim 7, however, only the second sensor is an interdigitated pressure wave transducer; the first sensor is an acoustic wave piezoelectric transducer. In addition, the Office is not correct in asserting that the Mochuzuki reference discloses two interdigitated sensors in a substantially orthogonal arrangement. Elements 12-1 and 12-2 are not sensors, but rather generators of surface acoustic waves (see col. 1, line 9 – col. 2, line 6; col. 3, lines 7-63). Only element 14 senses the convolution signals. Even where multiple sensors 14-1,14-2 are disclosed (Fig. 4), these sensors are not structured in a substantially orthogonal arrangement, nor do they detect pressure waves in substantially orthogonal directions. The application in spread spectrum communications of the surface acoustic wave convolver of the Mochuzuki reference is also quite far afield from the print head recited in claim 7.

In addition to the above discussion illustrating that the applied references do not teach or suggest all of Applicant's claim limitations, Applicant believes that the Office has failed to cite an appropriate suggestion or motivation to combine the Naoki and the Mansky references. The Office states that the motivation "would have been to obtain the advantage of the interdigitated wave sensor that can measure the dielectric constant and the conductivity of the material carrying the acoustic energy" (Office Action, p.3-4). Measuring the dialectric constant and conductivity of the material carrying the acoustic energy may be important to characterizing material properties of samples of organic or inorganic materials as taught by the Mansky reference, but Applicant fails to see how measuring the dialectric constant and conductivity would assist in any

way in detecting pressure waves induced by the firing of an ink expulsion mechanism. Accordingly, the Mansky reference is not properly combinable with the Naoki reference in that the Mansky reference provides no suggestion to combine and, in fact, teaches away from such a combination. There is no reasonable expectation of success that measuring the dialectric constant and conductivity would detect pressure waves induced by the firing of an ink expulsion mechanism.

Applicant respectfully traverses the Office's assertion that the claimed combination of Applicants' invention is obvious to a person having ordinary skill in the art based on the cited references, taken alone or in combination. Such could be possible only in hindsight and in light of Applicants' teachings. Therefore, the rejection is improper at least for these reasons and should be withdrawn.

Independent claim 23 (amended) is patentably distinguishable over the cited references because claim 23 emphasizes the novel features of the present invention in which two interdigitated pressure wave transducers of a print head detect pressure waves in substantially orthogonal directions. In this regard, claim 23 recites:

> "23. (Currently amended) A printhead for an inkjet printing apparatus comprising:
> a substrate;
> at least one ink ejector disposed on said substrate;
> an interdigitated pressure wave transducer disposed on said substrate and having a directional detection characteristic whereby a pressure wave traveling in a predetermined direction from said at least one ink ejector is detected; and
> a second interdigitated pressure wave transducer disposed on said substrate and having a directional detection characteristic oriented such that a pressure wave traveling in a second direction orthogonal to said predetermined direction is detected." (emphasis added)

The rejection of claim 23 is traversed for similar reasons as explained heretofore with regard to claim 7. The Naoki reference (Figs. 1 and 5) describes an ink jet head in which only a single sensor (distortion sensor in diaphragm 55) for detecting pressure waves is associated with a corresponding ink expulsion mechanism (heater 21). There is no teaching or suggestion in the

Mansky reference that two pressure sensors are configured to sense pressure waves formed by a particular firing of a particular ink expulsion mechanism. While the Mochuzuki reference does teach two sensors (14-1, 14-2) that are interdigitated pressure wave transducers, it does not teach or suggest that the two sensors have directional detection characteristics of pressure waves in which the directions are orthogonal to each other. Accordingly, the features of the present invention are not taught or suggested by the cited references.

Also as discussed above with reference to claim 7, the Office has failed to cite an appropriate suggestion or motivation to combine the Naoki and the Mansky references, and there is no reasonable expectation of success that measuring the dialectric constant and conductivity would detect pressure waves induced by the firing of an ink expulsion mechanism.

Applicant respectfully traverses the Office's assertion that the claimed combination of Applicants' invention is obvious to a person having ordinary skill in the art based on the cited references, taken alone or in combination. Such could be possible only in hindsight and in light of Applicants' teachings. Therefore, the rejection is improper at least for these reasons and should be withdrawn.

Independent claim 29 (amended), and its dependent claims 30-32, are patentably distinguishable over the cited references because claim 29 emphasizes the novel features of the present invention in which sensors can determine whether a nozzle is clogged or unclogged based on the time delay of the sensed pressure wave. In this regard, claim 29 recites:

"29. (Currently amended) A print head apparatus, comprising:
a substrate;
an ink expulsion mechanism provided on said substrate;
an ink well defined proximate said ink expulsion mechanism and a nozzle formed as an egress from said ink well; and
at least two pressure sensors that are formed substantially at said ink well and configured to detect pressure waves induced by a firing of said ink expulsion mechanism, wherein a pressure wave generated by a clogged nozzle has a time delay in the range of 15% to 20% less than a time delay generated by an unclogged nozzle." (emphasis added)

The features of the present invention are neither disclosed nor suggested by the Naoki reference in combination with the Mansky reference in that the limitation of a pressure wave generated by a clogged nozzle having a time delay in the range of 15% to 20% less than a time delay generated by an unclogged nozzle is absent from the references. Applicants respectfully traverse the Office's assertion that the claimed combination of Applicants' invention is obvious to a person having ordinary skill in the art. Such could be possible only in hindsight and in light of Applicants' teachings. Therefore, the rejection is improper at least for that reason and should be withdrawn.

Dependent claims 2, 4, and 8 have been rejected under 35 USC Section 103 (a), as being unpatentable over Japanese published patent application JP 11129472 by Naoki ("Naoki") in view of U.S. patent 6,438,497 to Mansky et al. ("Mansky"), and further in view of U.S. patent 5,023,625 to Bares et al. ("Bares"). Applicant respectfully traverses the rejection and request reconsideration based on the dependence of these claims on independent claim 7, whose reasons for allowability over the Naoki and Mansky references have been discussed heretofore and against which the Bares reference has not been cited.

Claim 9 has been rejected under 35 USC Section 103(a), as being unpatentable over Japanese published patent application JP 11129472 by Naoki ("Naoki") in view of U.S. patent 6,438,497 to Mansky et al. ("Mansky"), and further in view of U.S. patent 5,003,213 to Mochuzuki et al. ("Mochuzuki "). Applicants respectfully traverse the rejection and request reconsideration based on the amendment to claim 9 and features in the claim which are neither disclosed nor suggested in the cited references, taken either alone or in combination.

Independent claim 9 (amended) is patentably distinguishable over the cited references because claim 9 emphasizes the novel features of the present invention in which two interdigitated pressure wave transducers of a print head detect pressure waves in substantially orthogonal directions. In this regard, claim 9 recites:

"9. (Currently amended) A print head apparatus, comprising:
a substrate;
an ink expulsion mechanism provided on said substrate;
an ink well defined proximate said ink expulsion mechanism and a nozzle formed as an egress from said ink well;
a first pressure sensor that is formed substantially at said ink well and configured to detect pressure waves induced by a firing of said ink expulsion mechanism, wherein said first pressure sensor is an interdigitated pressure wave transducer; and
a second pressure sensor that is an interdigitated pressure wave transducer configured to detect the pressure waves induced by the firing of said ink expulsion mechanism, wherein said first sensor and said second sensor are provided in a substantially orthogonal arrangement on said substrate." (emphasis added)

The rejection of claim 9 is traversed for similar reasons as explained heretofore with regard to claim 7. The Naoki reference (Figs. 1 and 5) describes an ink jet head in which only a single sensor (distortion sensor in diaphragm 55) for detecting pressure waves is associated with a corresponding ink expulsion mechanism (heater 21). There is no teaching or suggestion in the Mansky reference that two pressure sensors are configured to sense pressure waves formed by a particular firing of a particular ink expulsion mechanism. While the Mochuzuki reference does teach two sensors (14-1, 14-2) that are interdigitated pressure wave transducers, it does not teach or suggest that the two sensors are arranged in a substantially orthogonal arrangement. Accordingly, the features of the present invention are not taught or suggested by the cited references.

Also as discussed above with reference to claim 7, the Office has failed to cite an appropriate suggestion or motivation to combine the Naoki and the Mansky references, and there is no reasonable expectation of success that measuring the dialectric constant and conductivity would detect pressure waves induced by the firing of an ink expulsion mechanism.

Applicant respectfully traverses the Office's assertion that the claimed combination of Applicants' invention is obvious to a person having ordinary skill in the art based on the cited references, taken alone or in combination. Such could be possible only in hindsight and in light of Applicants' teachings. Therefore, the rejection is improper at least for these reasons and

should be withdrawn.

Claims 10, 12-14, and 33 have been rejected under 35 USC Section 103(a), as being unpatentable over Japanese published patent application JP 11129472 by Takeshi ("Takeshi") in view of U.S. patent 5,023,625 to Bares et al. ("Bares"). Applicants respectfully traverse the rejection and request reconsideration based on the amendment to claims 10 and 33, and features in the claim which are neither disclosed nor suggested in the cited references, taken either alone or in combination.

Independent claim 10 (amended), and its dependent claims 12-14 and 33, are patentably distinguishable over the cited references because claim 10 emphasizes the novel features of the present invention in which a sensor mechanism can determine whether a nozzle is clogged or unclogged based on the magnitude of the sensed pressure wave. In this regard, claim 10 recites:

"10. (Currently amended) A print head apparatus, comprising:
a substrate;
an ink expulsion mechanism formed on a first side of said substrate;
a cover plate spaced from said ink expulsion mechanism and having a nozzle formed therein, said nozzle being aligned with said ink expulsion mechanism; and
a sensor mechanism formed on the first side of said substrate that is capable of detecting a pressure wave of a first non-zero magnitude indicative of when said nozzle is clogged and a pressure wave of a second non-zero magnitude different from said first non-zero magnitude indicative of when said nozzle is unclogged, wherein the first non-zero magnitude is in the range of 15% to 25% less than said second non-zero magnitude." (emphasis added)

The Takeshi reference describes a piezoelectric electroacoustic converter which detects a sound wave produced from a bubble generated by a heating element of an ink jet recorder in connection with the expulsion of ink (Abstract). Figs. 7A and 7B illustrate the output signal from the electroacoustic converter for normal ink associated with an unclogged nozzle, and thickened ink associated with a clogged nozzle, respectively ([0062]). While there does not appear to be a difference in the magnitude of peak Pn (associated with cellular generation) regardless of whether the ink is normal or thickened, the magnitude of peak Pc (associated with cellular disappearance) is somewhat smaller for thickened ink than for normal ink ([0064]). The

Takeshi reference teaches that comparator threshold Vth is to be set at a value that is below the magnitude of peak Pc for normal ink and above the magnitude of peak Pc for thickened ink ([0065]). However, it does not disclose or suggest that the magnitude of peak Pc for thickened ink is 15% to 25% less than the magnitude of peak Pc for normal ink.

The Bares reference is not cited by the Office with reference to the sensor mechanism or its operation, but is cited merely for the disclosure of a top-shooter geometry.

Therefore, the features of the present invention are neither disclosed nor suggested by the Takeshi reference in combination with the Bares reference. Applicants respectfully traverse the Office's assertion that it would have been obvious to a person of ordinary skill in the art at the time the invention was made to include the claimed features of Applicants' invention. Such could be possible only in hindsight and in light of Applicants' teachings. Therefore, the rejection is improper at least for that reason and should be withdrawn.

Dependent claim 33 is further patentably distinguishable over the cited references because they emphasize the novel features of the present invention in which a sensor mechanism can determine whether a nozzle is clogged or unclogged based on the time delay of the sensed pressure wave. In this regard, claim 33 recites:

"33. (Currently amended) The apparatus of claim 10, wherein said pressure wave of said first non-zero magnitude occurs at a first time delay and said pressure wave of said second non-zero magnitude occurs at a second time delay, and wherein the first time delay is in the range of 15% to 20% less than the second time delay." (emphasis added)

The Takeshi reference discloses that the time delay Tnc between peak Pn and peak Pc is greater for thickened ink associated with a clogged nozzle (Fig. 7B) than for normal ink associated with an unclogged nozzle (Fig. 7A). Conversely, claim 33 recites that the first time delay associated with a clogged nozzle is less than the second time delay associated with an unclogged nozzle; more specifically, 15% to 20% less. Therefore, the rejection of claim 33 is improper for this additional reason as well.

## Formalities

Claim Objections

Claims 17, 19-22, 26, and 27 have been objected to for incorrect status as a result of having previously been non-elected. In response, the status of these claims has been changed to "Withdrawn".

## Conclusion

Attorney for Applicant(s) has carefully reviewed each one of the cited references made of record and not relied upon, and believes that the claims presently on file in the subject application patentably distinguish thereover, either taken alone or in combination with one another.

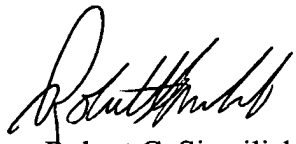
Therefore, all claims presently on file in the subject application are in condition for immediate allowance, and such action is respectfully requested. If it is felt for any reason that direct communication with Applicant's attorney would serve to advance prosecution of this case to finality, the Examiner is invited to call the undersigned Robert C. Sismilich, Esq. at the below-listed telephone number.

**AUTHORIZATION TO PAY AND PETITION**

**FOR THE ACCEPTANCE OF ANY NECESSARY FEES**

If any charges or fees must be paid in connection with the foregoing communication (including but not limited to the payment of an extension fee or issue fees), or if any overpayment is to be refunded in connection with the above-identified application, any such charges or fees, or any such overpayment, may be respectively paid out of, or into, the Deposit Account No. 08-2025 of Hewlett-Packard Company. If any such payment also requires Petition or Extension Request, please construe this authorization to pay as the necessary Petition or Request which is required to accompany the payment.

Respectfully submitted,



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